IN THE CLAIMS

We claim:

1. A method comprising:

dispensing a liquid onto a topside of a horizontally spinning 300 mm wafer from a single dispense centered approximately over the wafer; and

maintaining a combination of wafer spin rate and liquid flow rate that is above a curve defined by the combinations of approximate wafer spin rates and approximate liquid flow rates of 2000 rpm and 1.25 l/min, 1000 rpm and 2.2 l/min, and 200 rpm and 3.4 l/min.

2. The method of claim 1, wherein the topside of the wafer is hydrophobic.

3. The method of claim 1, wherein the topside of the wafer is partially hydrophobic.

4. The method of claim 1, wherein the wafer spin rate is at least 1000 rpm.

5. The method of claim 1, wherein the wafer spin rate is in the approximate range of 1000 rpm and 3000 rpm.

6. The method of claim 1, wherein the flow rate in the approximate range of 0.5 ml/min and 2.0 ml/min.

7. The method of claim 1, wherein the flow rate is approximately 1.5 ml/min and the wafer spin rate is approximately 2250 rpm.

8. The method of claim 1, wherein the liquid is a modified SC-1 cleaning solution comprising ammonium hydroxide, hydrogen peroxide, water, a chelating agent, and a surfactant.

9. The method of claim 1, further comprising dispensing the liquid in a sweeping dispense of a single dispense line toward an edge of the wafer.

10. The method of claim 9, further comprising decreasing the wafer spin rate.

11. The method of claim 10, wherein decreasing the wafer spin rate is simultaneous to dispensing the liquid in the sweeping dispense.

12. The method of claim 1, wherein the liquid is a combination of a first liquid and a second liquid dispensed concurrently.

13. The method of claim 12, wherein the second liquid is dispensed concurrently to the first liquid for within the approximate range of 1 second to 3 seconds.

14. The method of claim 12, wherein the second liquid is dispensed concurrently to the first liquid for approximately 2 seconds.

15. The method of claim 12, further comprising stopping dispensing the first liquid while dispensing the second liquid, and continuing dispensing the second liquid.

16. The method of claim 12, wherein the first liquid is an HF etch solution and the second liquid is a distilled water rinse.

17. The method of claim 12, wherein the first liquid is a distilled water rinse and the second liquid is a modified SC-1 solution.

18. The method of claim 12, wherein the first liquid is an alkaline solution and the second liquid is a neutral solution.

19. The method of claim 1, further comprising adding a surfactant to the liquid.

20. A method comprising:

providing a 300 mm silicon wafer in a horizontal spinning single wafer apparatus, the wafer having a hydrophobic topside;

dispensing a liquid at a flow rate of approximately 1.5 l/min from a single dispense approximately centered over the topside of the wafer to cover the hydrophobic topside of the wafer with the liquid while maintaining a wafer spin rate of approximately 2250 rpm to cover the topside of the wafer with the liquid.

21. The method of claim 20, wherein the liquid is a modified SC-1 cleaning solution.

22. The method of claim 20, wherein the liquid is a distilled water rinse.

23. A method comprising:

applying a solution having first pH to the topside of a horizontally positioned spinning wafer to form a liquid layer, the wafer spinning at a first spin rate;

minimizing the turbulence in the liquid layer during a transition in the liquid layer from the first pH to a second pH, the wafer spinning at a second spin rate during the transition;

maintaining the second pH in the liquid layer while the wafer is spinning at a third spin rate.

24. The method of claim 23, wherein the first pH is in the approximate range of 9 and 10.

25. The method of claim 23, wherein the second pH is approximately 7.

26. The method of claim 23, wherein minimizing turbulence within the liquid layer during the transition comprises keeping the second spin rate below 500 rpm.

27. The method of claim 23, wherein minimizing turbulence within the liquid layer during the transition comprises keeping the second spin rate below 200 rpm.

28. The method of claim 23, wherein minimizing turbulence within the liquid layer during the transition comprises keeping the second spin rate at approximately 50 rpm.

29. The method of claim 23, wherein minimizing turbulence within the liquid layer during the transition comprises changing the first spin rate to the second spin rate at a rate of less than 100 rpm/second.

30. The method of claim 23, wherein minimizing turbulence within the liquid layer during the transition comprises changing the first spin rate to the second spin rate at a rate of less than 50 rpm/second.

31. The method of claim 23, wherein minimizing turbulence within the liquid layer during the transition comprises changing the first spin rate to the second spin rate at a rate of approximately 5 rpm/second.

32. The method of claim 23, wherein the liquid layer has a thickness sufficient to prevent the deposition of particles onto the topside of the wafer.

33. The method of claim 32, wherein the thickness of the liquid layer is in the approximate range of 0.5 mm and 3.0 mm.

34. The method of claim 32, wherein the thickness of the liquid layer is approximately 1 mm.

35. The method of claim 23, further comprising heating the wafer to a temperature greater than that of the liquid layer.

36. The method of claim 35, wherein the wafer is heated to a temperature in the approximate range of 20°C and 90°C greater than the temperature of the wafer.

37. A method, comprising:

dispensing a first liquid onto a wafer, the first liquid having a first temperature and a first pH;

reducing the temperature of the first liquid so that the first liquid has a second temperature lower than the first temperature and a second pH that is substantially equal to the first pH; and

replacing the first liquid at the second temperature and second pH with a second liquid, the second liquid having a third temperature substantially equal to the second temperature and a pH substantially lower than the second pH to prevent an agglomeration of a plurality of etched species.

38. The method of claim 37, wherein the first temperature of the first liquid is in the approximate range of 50°C and 80°C.

39. The method of claim 37, wherein the second temperature is in the approximate range of 10°C and 50°C.

40. The method of claim 37, wherein the second temperature is approximately 40°C.

41. The method of claim 37, wherein the first pH is in the approximate range of 9 –10.

42. The method of claim 37, wherein the second pH is approximately 7.

43. The method of claim 37, wherein the first liquid is an alkaline solution and the second liquid is de-ionized water (DI water).

44. The method of claim 37, wherein reducing the temperature of the first liquid is done by introducing a third liquid into the first liquid, the third liquid having a fourth temperature that is significantly lower than the first temperature.

45. The method of claim 44, wherein the third liquid is DI water.

46. The method of claim 44, wherein the third liquid is an alkaline solution.

47. The method of claim 44, including introducing the third liquid into the first liquid prior to dispensing the mixture of the third and first liquids onto the wafer.

48. The method of claim 44, including introducing the third liquid into the first liquid on a surface of the wafer.

49. The method of claim 37, including spinning the wafer in a horizontal orientation.

50. The method of claim 37, wherein the first liquid has a concentration of etchant species, the method further comprising:

reducing the concentration of the etchant species in the first liquid prior to replacing the first liquid with the second liquid.

51. A method, comprising:

dispensing a cleaning solution onto a wafer, the cleaning solution having a first concentration of etchants and capable of etching at a first etch rate producing a first amount of etch products in the cleaning solution;

modifying the cleaning solution so that the cleaning solution is capable of etching at a second etch rate lower than the first etch rate and producing a second amount of etch products in the cleaning solution lower than the first amount of etch products; and

performing a pH transition of the cleaning solution while the cleaning solution has the second amount of etch products to prevent the formation of particle defects on a surface of the wafer.

52. The method of claim 51, wherein the second etch rate is in an approximate range of 0 Å/min and 3 Å/min.

53. The method of claim 51, wherein the second etch rate is approximately 2 Å/min.

54. The method of claim 51, wherein modifying the cleaning solution comprises replacing the cleaning solution with a second solution having a second concentration of etchants lower than the first concentration.

55. The method of claim 51, wherein the second solution has a second concentration in the approximate range of 3 times to 5 times lower than the first concentration.

56. The method of claim 51, wherein the second solution has a second concentration of approximately 4 times lower than the first concentration.

57 The method of claim 51, wherein modifying the cleaning solution comprises diluting the cleaning solution with a second solution having a lower concentration of etchants than the cleaning solution.

58. The method of claim 51, wherein the cleaning solution is a modified SC-1 solution.

59. A method comprising:

dispensing a modified SC-1 cleaning solution having a temperature in the approximate range of 50°C and 80°C to a top surface of a horizontally spinning wafer having a first spin rate of approximately 8 rpm for approximately 25 seconds;

increasing the first spin rate to a second spin rate of approximately 50 rpm at a rate of approximately 5 rpm/second while dispensing a first solution of deionized water having an approximate temperature of 20°C onto the top surface of the wafer; and

stopping the dispensing of the modified SC-1 cleaning solution but maintaining the dispensing of the first solution of deionized water while dispensing a second solution of deionized water having a temperature of approximately 80°C for 15 seconds at the second spin rate.

60. The method of claim 59, further comprising increasing the second spin rate to a third spin rate of 200 rpm for 20 seconds while continuing to dispense the first solution of deionized water and the second solution of deionized water.

61. The method of claim 59, wherein the modified SC-1 solution is dispensed at a flow rate of approximately 4.0 l/min.

62. The method of claim 59, wherein the first deionized solution and the second deionized solution combined are dispensed at a flow rate of approximately 4.0 l/min.